FROM PRINCIPLES TO ACTION: INCENTIVES TO ENFORCE COMMON PROPERTY WATER MANAGEMENT

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Abstract: It is now commonplace to acknowledge the long history and broad geographical spread of common property resource management schemes. At present, common property solutions are also debated in arenas such as climate change (where the atmosphere is the commons) and water allocation. These discussions raise general questions about the efficiency and equity of cooperative solutions as well about the likelihood of their implementation. Several factors are relevant in this context: how actors overcome collective action problems in order to create a community of users (i.e., how to prevent "exit"), how to regulate overuse and thus prevent dissipation of resources (i.e., how to control "entrance"), and how to maintain open and democratic decision-making about property use to assure efficient and equitable exploitation. In the high mountain communities of the Valais, common property management of some water and land resources has a long history which has continued until today. The practice is well-documented, providing a wealth of data to examine the evolution of village-level institutions developed to regulate their uncertain resource base in order to meet the needs of current and future generations. This chapter argues that individual incentives and collective control produced systems that were both efficient and equitable. These historical solutions are relevant to contemporary challenges concerning collective action and resource management.

Keywords: common property management, cooperation, equity, efficiency

1. COLLECTIVE RESOURCE MANAGEMENT: REAL BUT NOT OBVIOUS

It has now become commonplace to acknowledge the long history and broad geographical spread of common property resource management schemes. Scholars have gone beyond the "tragedy of the commons" argument (Hardin 1968), which contends that common property systems

E. Wiegandt (ed.), Mountains: Sources of Water, Sources of Knowledge, 63–79.

by their very nature cannot produce sustainable resource use. In this view, dissipation of the resource occurs because each individual maximizes the benefits from his own use of the resource but shares the costs and negative effects with all other users. This process results in an incorrect evaluation of the relation between costs and benefits, which encourages overuse of the resource and leads, ultimately, to its destruction. Numerous empirical studies throughout the world contradict this conception by showing that common property arrangements are in fact present in many regions and have existed for long periods of time—an observation also made in Paul Trawick's chapter in this volume.[1] Moreover, these studies identify factors that in fact favor collective over private property rights systems.

Current debates about sustainable development and climate change take up these arguments to highlight the relevance for today of the kinds of common property solutions described for historic communities. Dilemmas posed by regulating the global atmosphere or allocating scarce water resources invite reflection on a range of management strategies, including property rights solutions. Key questions at the heart of these discussions revolve around how to foster the cooperation necessary to implement common property arrangements and how to assure that such cooperative solutions produce efficient and equitable outcomes. These are particular manifestations of the more general problem of collective action. The first basic question is how to reconcile private interests and the public good. Related to this are the issues concerning how actors create a lasting community of users (i.e., prevent "exit"), how they regulate use and thus prevent dissipation of resources (i.e., how to control "entrance") and, once the balance of numbers is achieved, how they maintain open and democratic decision-making about property use to assure both efficiency and fairness (how to foster "voice").[2]

In the face of such challenges, the passage from principle to action is not obvious. The case of water resources, with their specificities and associated management problems, highlights some key dilemmas. To address these broad issues of vital importance to our contemporary world, it is enlightening to explore local level and historic property management schemes. The Swiss case has been invoked by numerous scholars because of its persistence and its apparent effectiveness in regulating scarce natural

[1] The McCay and Acheson volume published in 1987 was one of the first to bring together case studies demonstrating the robustness of common property arrangements. Today there is not only a vast and interdisciplinary literature on the subject, but also academic associations devoted to the topic, such as the International Association for the Study of Common Property (IASCP).

[2] Reference here is to the work of A.O. Hirschmann (1970).

resources (Dubuis 1999; Netting 1981; Stevenson 1991; and the special conference volume of the Société d'histoire du Valais romand 1995). The particular example of the history of water use in the Swiss Alps is presented here to describe how some mountain communities successfully solved collective action problems and developed intricate common property systems to regulate the use of scarce and vital natural resources.

In communities at high elevations in the Valais, a mountainous canton in southwestern Switzerland, water and some land resources are still managed according to common property principles. Their history is well-documented, providing us with a wealth of data to examine the evolution over several centuries of institutions developed by local communities to regulate use of their uncertain resource base in order to meet the needs of each generation without compromising the welfare of future generations. At the heart of the system were incentives that made cooperation preferable to noncooperation. We will discuss these historical patterns of allocation in small communities faced with limited and variable quantities of water to illustrate some of the general problems of collective action and resource management that bedevil today's world and show how they were solved in the Alpine context.

2. CHARACTERISTICS OF WATER RESOURCES

A brief review of some aspects of water resources is helpful to highlight the particular problems their management entails. All those who study fresh water make the obvious point that it is essential for survival and has no substitutes. Not only is water necessary to maintain the life of humans, animals, and plants, it also furnishes significant amounts of energy, making competition over types of use inevitable. These multiple uses are subject to social decisions about allocation. However, available quantities are only partly determined by human action. Challenges imposed by natural forces have therefore always influenced the supply and distribution of water, leading to very early allocation schemes. Mountain regions, although often defined as "water towers" (see Viviroli and Weingartner in this volume), are not exempt from management problems. On the one hand, water may be overabundant and cause floods and landslides; on the other, it may not have optimal seasonal distribution. Moreover, the apparent upland advantage may be transformed into conflicts with downstream neighbors, as is starkly apparent in other chapters in this book by Güner (on Turkey) and Luterbacher and Mamatkanov (on Central Asia). The notion of abundance is itself a relative concept and evolves as

societies' needs and wants change. Like the atmosphere, which until recently was a pure public good, pollution and climate in effect modify the quantity of water available by affecting its quality. Management strategies must therefore address these interrelated aspects of resources.

Property rights are a fundamental mechanism to achieve sustainable resource use. As a set of entitlements, they specify the rights, privileges, obligations, and limitations associated with an entity. Property rights are, in effect, quotas that control access and intensity of use. If working correctly, they should prevent resource dissipation and ensure that exploitation of any given resource will not hit diminishing returns. In this way, the given resource will continue to meet needs across space and through time with greatest efficiency. Different types of rules can apply, ranging from collective forms such as open access (the object of Hardin's critique) and common property, to individual arrangements embodied by private property. Because of the wealth of existing work on this subject, we will not discuss this in any detail here but will point only to several key contrasts among perspectives.

Economic orthodoxy has often presented private property rights as superior because they lead to more efficient use of the resource. Ronald Coase notably argued that negative environmental externalities would be minimized through competitive markets for them (Coase 1960). Both theoretical and empirical work question the generality of this conclusion, however. The fundamental precondition for such markets is the existence and enforcement of property rights but, as Dasgupta and Heal point out, these may be either difficult to define or difficult to enforce (1979). Flowing water, for example, cannot be treated as a separate commodity because is in a "constant state of diffusion"—or movement (Ibid. p. 49)—and a precise unit cannot be allocated to a single individual. In the case of pools of underground water, property rights can be defined as a given area of land, but it will never be clear whether the water extracted—because of its fluid nature—comes from below the designated area or from a wider area underlying the surface property of other owners.

The characteristics of water (and other resources like oil or fishing grounds) and various factors associated with some forms of their use have created conditions under which common property management is more likely to obtain: (1) The nature of the water and similar resources distinguishes them from others. Some resources like fish or animals move and must be "captured" to claim ownership. Water, air, and petroleum, on the other hand, cannot easily be divided into clearly defined units and must be "captured" through extraction. (2) Some resources benefit from economies of scale in their use. For example, preindustrial grazing land was often owned communally. Individually owned herds were small but could

benefit from large grazing areas and their owners could also share oversight duties. (3) Maintenance or capital investment often requires large groups, and collective ownership of the resource may be an effective way to mobilize the necessary capital or labor. (4) Private property rights must be protected and guaranteed. Enforcement costs may be too great to be carried by individual owners. Patrolling vast expanses of water to defend fishing zones or controlling how much water various users are withdrawing from a river or underground pool are examples of such costly monitoring or enforcement. Often these different factors are interdependent and it is the combination of the resource's inherent characteristics, technological features, and the institutional configurations related to its management that explain the existence of common property arrangements.

Specific qualities of water bring together many of the features frequently invoked as favoring common property management methods. It has fugitive aspects because it must be pumped or collected to be used. It can be a common pool resource when it is found in lakes or underground pools. It often requires large infrastructures such as irrigation systems, dams, or pumps to make it available. Finally, it is often difficult to protect from diversion. That we can identify common property water management systems through time and across space is therefore not surprising, but their presence and persistence raise further questions about how communities come together and develop rules and technologies that produce efficient and equitable water management—i.e., that avoid dissipation of the resource and free-rider problems that plague all cooperative human endeavors. The historic patterns in the Valais are a window into how general principles we have identified with common property regimes were translated into actions that guaranteed broad and long-term access to a vital resource.

3. WATER USE IN THE SWISS ALPINE AGRO-PASTORAL SYSTEM

The texture of Alpine life has been amply described by historians who tell the story of populations living primarily off their land base for much of history. The importance of adequate water resources for agriculture is evident (see, for example, the special volume of the Société d'histoire du Valais romand, 1995; Netting 1981, or Wiegandt 1980). First impressions of the rugged Alpine landscape of the Valais raise immediate questions about how people survived over generations among the steep mountains where sun was plentiful but winters were cold and long, and water scarce. Low rainfall could not guarantee sufficient seasonal or even total annual

water supply, especially as the population grew and evolved, making the history of the Valais also the history of the emergence of water management strategies. A solution that acquired importance beginning in the Middle Ages was to tap into the large stocks held by mountain glaciers and to develop an intricate irrigation system that brought summer melt waters to fields and pastures. The organization and operation of this system depended on cooperative resource management schemes that solved basic collective action problems inherent in the allocation of not only water but also of other resources critical to the Alpine production system, which was based on cereal grains, potatoes (after the eighteenth century), and cattle that provided milk, meat, and cheese.

Archaeologists and historians trace the origins of the Alpine agro-pastoral system to the Neolithic period, when grains were the staple food, complemented by small herds for meat and milk products (Dubuis 1990). Embedded in a feudal system, there is nevertheless evidence that plots were exploited and managed by households and that there was considerable autonomy exercised by communities as they took advantage of their physical distance from overlords. Complementing these household-based resources were collectively held forests, irrigation systems, and high alpine grazing lands. Coexistence of these private and communal resources had important consequences for resource management because it progressively led to norms and rules controlling the total number of people with rights to resources while at the same time protecting these rights from seizure by small elites.

The size of cattle herds, for example, was limited by mutually reinforcing rules. The number of cows that could be wintered on village territory could not exceed the amount of fodder produced from privately owned hay meadows, and only those cows that a household could winter could be sent to the communal summer pasture (*alpage*) (Netting 1981, p. 61). Moreover, the total number of animals allowed on each summer pasture was a fixed number that was set early in village history. The distribution of these shares, which could be inherited, bought, sold, or rented, determined which owners could alp what number of cows. These combined requirements simultaneously discouraged accumulation of private resources and individual capture of the commons and prevented overuse and depletion of common resources.

Controls over population growth constituted a parallel to rules about the use and distribution of resources. Demographic mechanisms and cultural rules influenced population size and growth rates. Consistent with the Western European demographic regime, Alpine communities were characterized by late age at marriage, high celibacy rates, and high emigration rates (Netting 1981; Wiegandt 1980), keeping population size

in balance with the resource base. The allocation of private resources was achieved through partible inheritance. Division of estates at each generation tended to equalize the average size of family holdings because of the observed tendency of wealthier families at any given time to have more children. As a consequence, their estates were divided into relatively more shares than those of poorer families (Wiegandt 1977, 1980).

Private holdings could be freely bought and sold as well as inherited, but communal resources, necessary to make any exploitation viable, could only be acquired by inheritance through the paternal line or sometimes through marriage. This effectively limited the number of in-migrants, who would not automatically have access to vital resources. Rules for granting or restricting *bourgeoisie* status (community membership) rights to other inhabitants, such as spouses of members or new families, were loosened or tightened at different times in history to adapt to conditions that warranted either higher or lower population levels (Wiegandt 1977).

The integrated system of population dynamics and resource use and management that evolved in the Valais prevented overexploitation and dissipation of a scarce resource base and thus avoided a tragedy of the commons. How did this come about and how were individuals or small groups prevented from gaining monopoly control over critical resources? Institutional innovations in periods of crisis shed light on factors that translated principles of solidarity into action, which then became part of the characteristic Alpine culture.

4. THE EMERGENCE OF A WATER MANAGEMENT SYSTEM

As the Alpine production system successively met challenges from the environment and from the constraints and opportunities of the evolving Swiss state (Wiegandt 2004), it elaborated strategies that resolved the tragedy of the commons dilemma without eliminating individual incentives. At each step, choices were made to address particular needs; the cumulative effect was a system that smoothed economic differences among families over time and fostered cooperative behavior. A major shift in the production system during the Middle Ages illustrates how changes in basic conditions led to a response built on existing norms, reinforcing some in ways that in turn produced the features of mixed property systems and collective commons management.

In the Middle Ages, cereal grains formed the basis of the Alpine productions system. Evidence from the historical record shows that most

land for these crops was privately owned. In the fourteenth century, the Plague struck the region, decimating the population, as it did throughout Western Europe. The epidemic had many consequences that have been amply studied. One was to change the dynamics of supply and demand for foodstuffs. Le Roy Ladurie (1971) has demonstrated for other regions and sectors that the decline in population following the Plague favored new technologies and production strategies. Slowly there was a general increase in well-being, accompanied by new patterns of social relations as some individuals and groups profited more than others from new opportunities.

In a similar vein, Dubuis (1999) shows that, in the Valais, the high mortality caused by the Plague and the ensuing drop in population led to abandonment of arable land. It was neither left fallow nor later returned to grain fields, however. Through land records, he traces the shift in land use patterns and the increase in number of cattle and stable buildings as evidence of the newly emerging production system that transformed fields into hay meadows. There were two main reasons for this. Lower population levels meant decreased demand for cereal grains. This was to some degree countered by new opportunities from increased demand for meat from cities in the Piedmont and Lombardy regions of Italy. To respond to both of these changes, there was a move to increase animal production, which is less vulnerable to changes in demand because animals need not be slaughtered for their meat at any predetermined time and their by-products can be stored if milk is turned to cheese. The result of the shift in emphasis from grains to herding was a greater flexibility of the system in responding to variations both in supply and demand because of the "storage" capacity represented by live animals. At the beginning, however, it also underscored social differences because, according to Dubuis, the new system was introduced primarily by wealthier peasants, who would be most able to absorb the risks associated with the change in production strategies (Ibid., p. 85).

Despite its adaptive advantages, cattle-raising in the Alpine environment solicited the local environment in a different way and placed new burdens on the organization of labor. Grain production persisted because cereals remained an essential part of diet. There were significant advantages in producing these foodstuffs locally in this Alpine environment, where transportation was arduous. Food self-sufficiency was linked to political autonomy, given that resources were also owned and managed by users. These positive effects were nevertheless achieved at the expense of greater pressures on time and organization of work. Scheduling of tasks became more complicated in this mixed economy. Cattle require constant attention throughout the year, making summer months extremely busy. Not

only were there the regular feeding and milking chores during the summer, grains had to be harvested. And, with the increased importance of cattle production, there was the additional task of cutting hay for wintering-over of the cattle.

The need to produce hay introduced competition for space as well as for time because land nearest the village was needed for several purposes—for grain fields, haying meadows, and pasture. Possibilities for territorial expansion were limited, as the earliest historical documents preserved in the majority of Valaisan communities attest. Most of the documents concern various land grants and records of arbitration between communities over boundary conflicts, thus suggesting that there was little unclaimed land even in early historical periods. The only choices were to expand into previous unused lands, such as high-mountain pastures, or to deforest. The perennial need for wood for heating, cooking, and construction made forest preservation an important priority, and therefore the area of forest that could be cleared for additional meadow or pasture was also limited. Communities early on set limits that kept the balance between forest and cultivated land relatively stable throughout the ages. Acquiring pastureland at some distance from the village (up to several days' walk) was a strategy adopted at certain times by some villages (Netting 1981, p. 51) but this put pressure on the efficient use of a small labor pool composed only of villagers. The addition to the resource base of a previously unused high summer pasture thus conferred certain advantages. It provided an additional source of nourishment for the animals. It also became a way to optimize villagers' time. All the village cows grazed together in the summer pasture and were cared for by a small team, thus freeing their owners from milking and feeding chores and enabling them to spend time to cut hay and harvest grains. This strategy was adopted throughout the region and has become an essential feature of the Valaisan agro-pastoral system.

This new and major need to produce additional animal fodder was introduced by the intensification of herding. Growing more grass could not be accomplished with the low levels of precipitation in the region, however. What we observe in the historical record is that peasants increasingly turned to the water produced by snow melt and glacial runoff. They could only efficiently exploit these sources by bringing water from high altitude streams and developing a means to distribute it over the arable lands around the village. Thus, during the course of the fifteenth century throughout the Valais local inhabitants designed and built their complex system of small, locally, and collectively managed irrigation

systems (*bisses*).[3] In doing so, they were confronted with significant cooperation and collective action problems that we have outlined in our earlier theoretical discussion on water management, where we also suggested several factors that would encourage their configuration as a common property resource.

Runoff from glaciers poses an upstream-downstream problem because those at higher altitudes could divert water, leaving little or none to downstream users. In the characteristic Valaisan land use pattern, individuals held land both at higher and lower latitudes (to spread risks of microclimatic factors) and thus everyone had an interest in guaranteeing equitable distribution throughout the territory. The nature of the system also favored cooperative management. Although the irrigation canals were not major infrastructures, they nevertheless required levels of labor input and coordination among users that went beyond household capabilities. Each community faced the same limits in potential labor or capital inputs, making water trade between communities with unequal investments unlikely. These factors correspond to the general criteria outlined earlier as favoring collective management systems over private ones and helps explain their emergence in the Valais.

At the same time that collective ownership was being consolidated, private ownership of individual meadows and fields persisted, leading to the characteristic mix of common and private holdings in the Valais. The coexistence of the two forms is fundamental in explaining the puzzle of why and how principles of common property and collective management could be translated into a working system that put these principles into action. The interaction between private and collective resources facilitated the resolution of the well-known free rider problems associated with public goods and allowed Valaisan communities to achieve the level of cooperation that was necessary to create and maintain collective management of water and land resources.

Herding and the attendant upkeep of pasture and irrigation systems brought new kinds of returns that could only be achieved through greater labor investments, a different use of time, and the reallocation and reorganization of resources—particularly water. Digging irrigation canals throughout the village territory to serve each individual field, pasture, and meadow,

[3] Dubuis notes that additional research will undoubtably produce a more nuanced account of the origin of irrigation systems and their collective management systems. Even within the already particular case of the Valais, important regional differences exist, especially between the lower part, which he analyzes, and the central and upper sections of the Rhône Valley where *bisses* existed already in the thirteenth century and where cattle trade was less well developed and villages more dependent on local production.

and then maintaining the channels and assuring the flow of water in an equitable and effective way, required significant inputs of labor. One solution would have been to hire additional labor, but most inhabitants of the community, even in the Middle Ages, were property owners themselves and it is not clear how many might have been willing or able to spend time working for others rather than on their own land. Bringing in outsiders as hired laborers would have been difficult because they would have been excluded from access to all the common resources that were an essential part of each holding. Difficult terrain would preclude traveling from any great distance to work as day laborers and the nearest communities would also primarily have only members who were also landowners. Moreover, even if surplus labor had been readily available, the land use pattern of scattered plots raised problems of how to control potential shirking. Additional laborers were thus a scarcity and this granted them bargaining power, especially since most of them would have had a viable resource base. We can imagine that some might be tempted to reduce the uncertainties in supply that the shift to cattle raising brought, but only if they were granted some attractive incentives. These might have included access to new water resources in exchange for their labor to establish and maintain the system. In such an arrangement, both parties would benefit from the increasing returns to scale associated with the new resources.

This scenario is speculative but tracks the historical data, which show that small numbers of villagers initially transformed grain fields into meadows. These were then followed by larger numbers who began making this conversion during the same period that saw the construction of irrigation systems and the introduction of their collective management. This description goes some way in explaining how individuals could benefit from their decision to join the commons; however, it does not explain how the system could maintain the benefits and protect the resource from the desire of too many to join, which would result in overexploitation.

We mentioned earlier the relationship between winter and summer feeding of cows and the implicit limit that the quantity of private resources placed on the number of cattle that could have access to communal resources. This in turn provided a fixed upper limit to the number of total use rights available for each given pasture. Water rights were similarly limited by a ceiling on their numbers and their association with particular plots of individually owned land. If an individual cleared a new plot, it would not have automatic access to irrigation water. Each water right translated into the time water would flow to a particular parcel of land, which was the equivalent of setting boundaries on the quantity available for each field or pasture and for the overall cultivated territory.

The mix of common and private property was thus the mechanism that set upper bounds on the number of users. It also prevented individuals from acquiring dominant shares of communal rights. Total shares of both water and pasture rights were fixed and those not inherited had to be purchased. They would have to be bought from fellow villagers equally dependent on them. Either other villagers would not relinquish the rights because they were essential for the survival of the household, or they would only do so at a very high price. Given that the buyer was another villager with very little surplus resources or capital, his capacity to meet the price would be limited. Using one's private resources to acquire rights to common ones was self-limiting because of the interaction between the two types of resources. Water rights were linked to specific plots of land so relinquishing a plot would obviate the need for water. Seeking to winter more cows in order to acquire more alpage rights would imply intensifying hay production, which necessitated more water and more labor. Both the number of cows a domestic unit could feed and the amount of hay it could cut with its own labor pool were limited. To hire additional labor in a largely nonmonetary economy meant generating surpluses beyond subsistence levels. This again required access to communal resources of water and pasture and, moreover, would produce few benefits because surpluses would go to pay the additional laborers. These factors all served to prevent the emergence of elites.

Not only access to resources was controlled. Decision-making power over resource management and use was also shared among community members through its decentralized structure. Water was not concentrated in a single main channel but was distributed among several canal systems, each with its separate management structure. Each village also typically had more than one high alpine summer pasture. A separate (but often overlapping) slate of user-managers was elected for each association to oversee the maintenance and operation of the resource in question. The small size of the membership groups, the likelihood that most members would at one time serve as a manager, and the intimate knowledge that each user acquired about the nature of the resource and its management, meant that everyone had equal and relatively complete information about the system. Because of their deep understanding, even when they were not part of the managing committee, villagers would closely follow decisions and undertake their own surveillance to assure that they received their share of water or pasture. Control was thus highly decentralized, another factor making it difficult for individuals or small groups to make any concerted attempt to capture control of these key resources. Maintenance was also a shared task of all the users, who formed corvée labor teams to clean the canals and pastures of debris every year and to assure the

free-flow of water in the irrigation canals during the watering season. The participatory decision-making that gave all users a stake in the system was accompanied by obligations to assure the persistence of the resource.

Harsh environmental conditions made it essential that a solidary group invest in and maintain resources. We have outlined the factors that tightly linked population and resources, such as late marriage, high celibacy and emigration rates, and citizenship rules that limited outsider access to common resources. In addition to these controls on population size that helped maintain a certain balance with the resource base, partible inheritance rules assured a circulation of resources throughout the community, protecting both private and public goods from overexploitation. Given the limits on private goods, the level of public goods was high to protect individuals and the community as a whole from the variability and uncertainties of the Alpine environment. Hirshleifer (1983) has categorized different forms of public good provision in different kinds of society. What we observe in the Valais corresponds to Hirshleifer's "weakest link" solution. Among the several possible variants of public good provision that he identifies, this form refers to systems in which a high degree of cooperation obtains because each individual's contribution is essential to prevent the collapse of the overall system. Thus, free riding must be kept to a minimum because it threatens the society as a whole.

Our description of Valaisan society has shown that numerous practices evolved to share risks from harsh and unpredictable climate. A single household could be devastated by an early frost, a late snow, or a rainy summer. Microclimatic effects typical of Alpine environments led to spatial variability in crop success. For this reason, a family domain spread its holdings across village territory. Additional protection came in the form of access to common resources that had to be protected for the good of individuals but also for the good of the whole. Without thriving individuals and families, the community could not survive because it relied on members to maintain the collective resources. These were in turn essential to form that buffer that kept individuals from slipping under minimal subsistence levels when crops failed. The practices associated with the use of public goods incorporated incentives for individuals to maintain them and also included rules that assured that they could not be captured for individual benefit. Information was widely diffused (there are rarely secrets in small communities) and governance decentralized. If knowledge was shared, power was more easily distributed and principles more easily became actions.

Our historical analysis suggests that the integrated system of resource use and management adopted in the Valais was based on the creation and maintenance of public goods. It required and reinforced a high level of

cooperation, which contributed to the success of mountain communities in preventing overexploitation and dissipation of a scarce resource base. A central feature of the system was the combination of private and collective types of property arrangements. The coexistence of different tenure systems is longstanding in the Valais, but as we have seen from the history of water management, the precise details of property arrangements governing resources varied over time. Institutional foundations for both private and common property management coexisted, giving villagers options when faced with new circumstances and challenges. This flexibility was surely important in the successful transition to new productive strategies. Its form is characteristic of the Valaisan system but similar mechanisms exist in very different cultures, such as among the Tigray in Ethiopia (Bauer 1987). To respond to changing population dynamics in a desert environment, villagers meet to redefine land between private and common forms of tenure over the space of generations. Myriad examples of flexible tenure systems could be described here but drawing on the Ethiopian case is simply to suggest that adaptive strategies can take the form of rapid or progressive shifts in their coexistence.

Contrary to arguments that claim superiority of either private or common forms of property, the Valaisan case study suggests that what matters is that rights must be clearly defined and the institutional framework must be able to enforce the rules. It also seems that when resources are scarce or their supply unreliable, mechanisms to assure broad access favors persistence of the community. In the Valais this access was achieved through norms encouraging a high level of cooperation among all community members. When these principles do not pertain, overuse is more probable and can lead to overexploitation and environmental degradation. Subsistence production is in fact particularly vulnerable to such outcomes because workers who depend on their own labor will produce even for declining returns just to assure their minimal needs. Real costs of production are not taken into account in the price, which leads to ever-increasing intensification and, ultimately, to resource depletion. This process characterizes many developing countries whose systems operate in world markets in which other regions have well-defined property rules and cost internalization.[4]

Valaisan peasants were subsistence producers like many contemporary farmers—particularly in the developing world—but they did not enter into the spiral of intensification and exhaustion of the resource base. They benefited from the closed nature of their community, where commerce was

[4] See Chichilnisky (1994) for a detailed development of this argument.

a complement to but not an integral part of the system during many historical periods. This high level of self-sufficiency accompanied by some degree of autonomy in decision-making over resource allocation kept outside powers at bay. During the feudal period, for example, many parts of the Valais used these leveraged freedoms to resist feudal domination and subsequently continued to keep their distance from the emerging state. Surely equally important was the fact that property rights, whether private or common, were clearly specified and effectively enforced and monitored.

Highlighting the central role of property rights in shaping economic and political processes is consistent with the views of recent scholars who have also argued that the appropriate definition of property rights can solve environmental problems (Chichilnisky 1994; Dasgupta 1992; Dasgupta and Heal 1979; and Demsetz 1967) They have also claimed that property rights solutions are in fact superior to other regulatory mechanisms (Chichilnisky 1994) for attaining sustainable resource use. The coexistence and interaction of both common and private property regimes has been identified in the case study presented here as a key factor in avoidance of resource depletion and in the equitable distribution of resources and risks. Moreover, the mix of private and common property structures in the Valais was the source of valuable flexibility in institutional response. Changing production technology, exemplified by the passage from cultivation to herding, facilitated transition from one property form to another. Once the two coexisted, they were each part of an enlarged set of available strategies to respond to changing environmental, political, or economic circumstances.

5. PAST PRINCIPLES, FUTURE ACTIONS

The contemporary efforts to craft environmental and resource regimes that provide equitable access to critical resources such as water or the atmosphere also rely on existing mechanisms and draw upon the theoretical findings underlying the analysis of different property rights systems. In this context, historical studies provide empirical evidence for the complexity and variability of arrangements, as well as the strengths and weaknesses of each. Common pool resources pose problems of definition and enforcement of rights. The shortcomings of private property rules identified theoretically by Dasgupta and Heal (1979) are implicitly confirmed by the common property strategies elaborated in order to overcome the distortions that can be introduced by private property principles. Of particular interest for contemporary environmental policy is the evidence of the coexistence of common and private property systems to regulate a single resource, either at

one time or over time. Both forms of management can provide valuable flexibility in institutional response and facilitate adaptation to changing production technologies. The passage from primarily grain cultivation to herding has been discussed in some detail for the Valais of the Middle Ages. More recent examples demonstrate the similar types of response. In the early part of the twentieth century, communities in the Valais used their collective control over water resources to negotiate favorable contracts with producers of hydroelectric power. They in effect rented the potential power derived from water flowing down the slopes within their territory to companies that exploited the force to generate electricity. Communities did not relinquish rights to the resource itself but sold rights to the energy implicit in its downward flow.

Currently the global population is faced with the dilemma of how to regulate public goods that are being threatened by overuse. The negotiation of the Climate Change Convention and the Kyoto Protocol address the problem of the global atmosphere as expressed by global warming. Presently there is no international agreement to regulate transboundary water use. In the context of our historical analysis, it is noteworthy that present-day environmental management strategies are based on the definition of new property rights and the mix between common and private rights systems. The mechanisms devised by Kyoto Protocol to regulate CO_2 emissions recognize the atmosphere as a common property resource but propose the creation of tradable permits that have characteristics of private property, similar to the shares in Valaisan pastures or irrigation systems. How these property principles will work out in practice will depend on governance and enforcement issues that were also foremost in historical arrangements.

The increasing inclusiveness and democratization of decision-making within local associations that characterized the introduction of new property rights to irrigation water in the Valais may also be relevant in thinking about ways to mobilize contemporary populations concerned by climate change or water shortages. For example, in the case of climate change, developing countries see no benefits in changing their emissions behavior while industrialized countries realize that no viable use of the global environmental commons is possible without developing country participation. It is imperative that incentives be devised at the individual (state) level in order to create a willingness to join collective and global efforts to regulate resources with public good aspects.

Debates similar to those over climate change are emerging in the public arena over the optimal systems to assure access to freshwater, pitting those who believe in open access to water and those who recognize the potential this has for its overuse and dissipation. Many who distrust

common property solutions propose mechanisms such as pricing schemes to confer value on the resource. They claim that this will define efficiency criteria and thereby lead to optimal levels of use. Others argue that people have an intrinsic right to essential quantities of fresh water.

As we stated in the beginning of this chapter, both private and common property systems have strengths and weaknesses. Some types of common pool resources pose particular problems to pure privatization related to issues of definition and enforcement of property rights. In these cases, equity and efficiency criteria can be met through common property rules. In the absence of strong existing institutions to protect private rights, cooperative solutions can emerge from a set of mutually reinforcing incentives and controls over individual efforts to acquire exclusive possession (of private rights) or to free ride (in collective systems). The difficulty is in achieving a proper balance. To many, private property rights lead to inequity and lack of innovation (Heller 2000), while uncontrolled common access ends in resource dissipation. Both outcomes threaten not only the social system as a whole but also each individual member. Common property solutions can address both challenges to sustainable resources use and social cohesion. The historical example of the Valais is evidence that property regimes are not immutable and that societies can innovate and solve problems posed by changing relations among their environments and social needs. Exploring concepts and theories may reveal other new arrangements that would improve welfare and protect resources. There is thus a continuing need to confront the puzzles of resource management and to identify potential gains from cooperative strategies.